Communication node section

Analog front end section
(Battery Performance Probe)

Daisy chain connector (In)

50
51
52
53
54

55

Opto-Insulators

V+
Vcc

Analog In
ADC 12 BITS

Node select in
Broadcast out
Broadcast in
Node select out

Out
Analog Mux.

Ch. 1
Ch. 2
Ch. 3
Ch. 4

Internal Data and Control bus

Micro-controller

Daisy chain connector (out)

55

10

Server V+
Server GND
Broadcast out
Broadcast in
Select out

V AC
V DC
V ACRef
Temp.

LPF

LPF

LPF

Peak det.
D A
R₉₀

Bandpass filter

Rac

R1

R2

F1
BUT
D1

Vcc

Vcc

Jumper

Voltage regulator

DC
DC

3
1
Battery string

3
3
3

Thermal sensor at reg. term.

Legend:

BUT - Battery Under Test
Vcc - Node internal supply
V+ - Server voltage supply
LPF - Low Pass Filter
Mux. - Multiplexer
V AC - AC component of battery voltage
V DC - Battery Voltage
V ACRef - AC channel reference

N te: The Jumper is used only for BPP 12 volts version. Any other version use DC/DC converter.

Fig. 1. Battery Node Block Diagram.
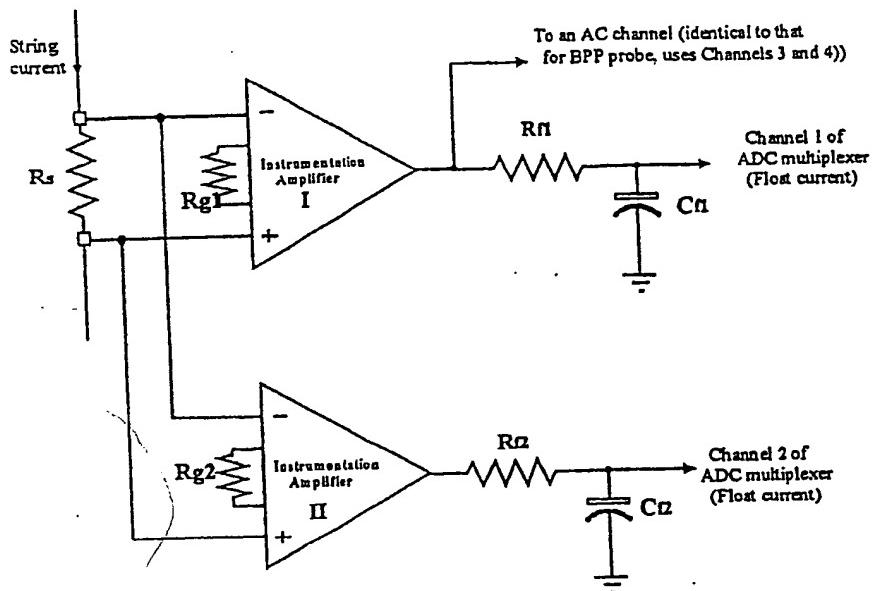
Fig.2. Current Probe Analog Front End
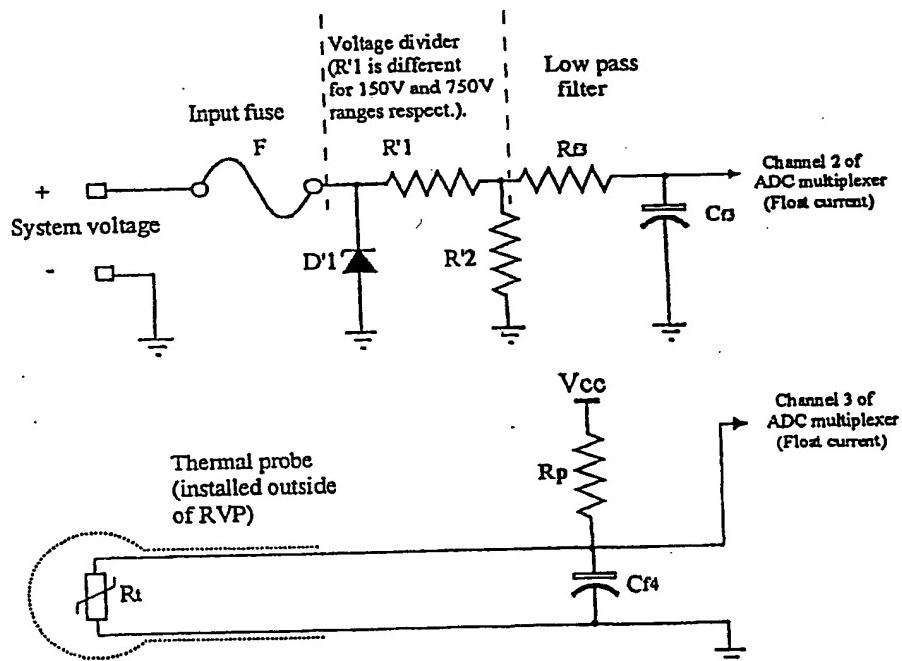

Fig. 3. Rectifier Voltage Probe Analog Front End
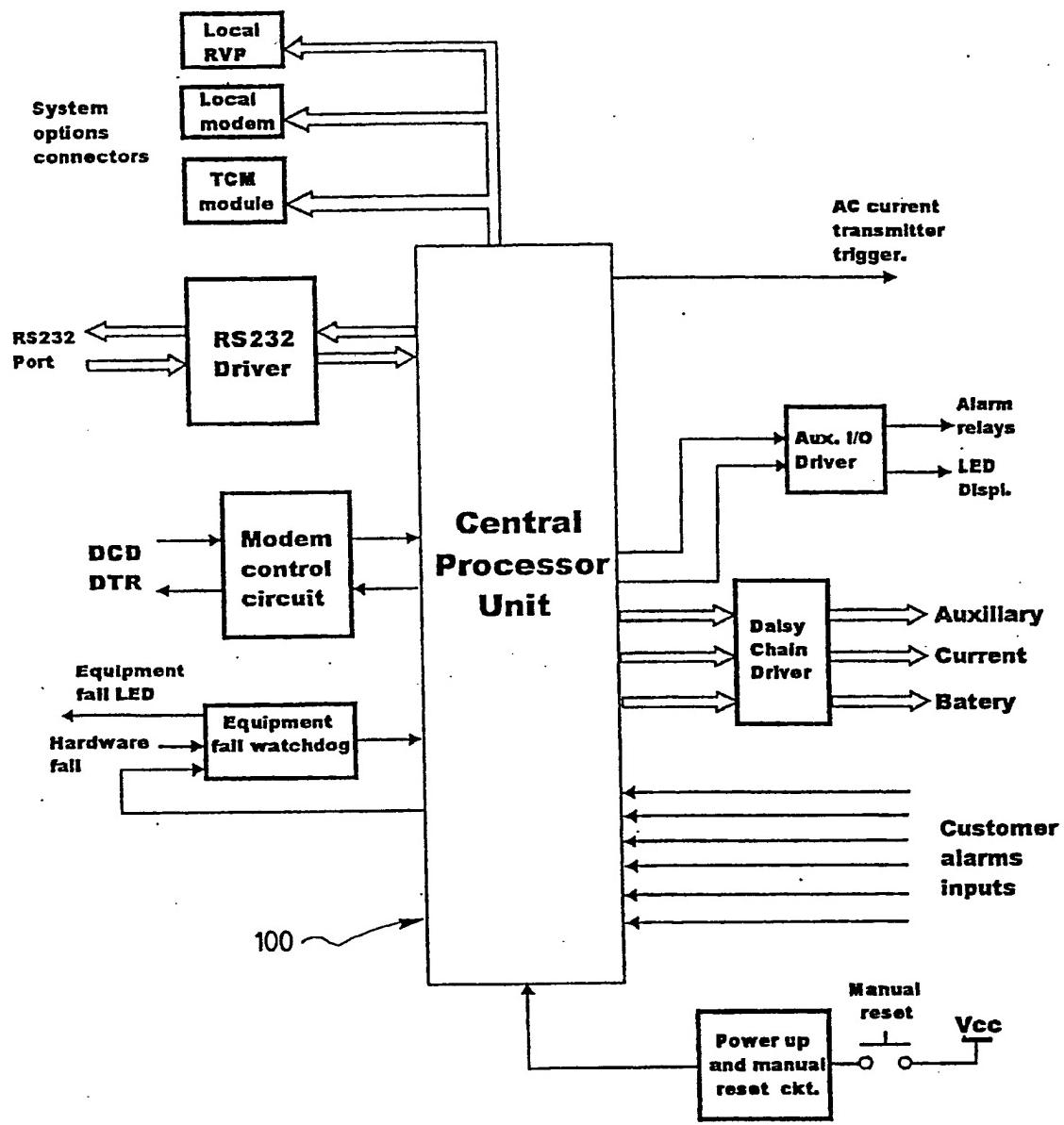
Fig. 4. System server block diagram

```
                                                    ┌─────────────────────┐
     ╱─────────────╱                                │  Display message    │
    ╱   Reset     ╱                          ┌──────▶│ "Initialization fail"│
   ╱   request   ╱                           │       └─────────────────────┘
  ╱─────────────╱                            │                  │
         │                                   │                  │
         ▼                                   │                  ▼
  ┌──────────────────┐                       │       ┌─────────────────────┐
  │ Send reset request│                      │       │  Stop initialization │
  │   to all nodes    │                      │       │      process         │
  └──────────────────┘                       │       └─────────────────────┘
         │                  Server sends      │
         │                  request to        │
         ▼                  first probe       │
  ┌──────────────┐                            │
  │ Select first │                            │
  │    node      │                            │
  └──────────────┘                            │
         │                                    │
         │              No response           │
         ▼              or corrupted          │
    ◇─────────◇         data                  │
   ╱ Is response ╲                            │
  ◇ acknowledged? ◇──NO──────────────────────▶│
   ╲             ╱                             │
    ◇─────────◇    Response accepted          │
         │                                     │
        Yes                                    │
         │                                     │
         ▼          First node accepts address │
  ┌──────────────┐  and send back              │
  │ Server assign│  acknowledgement            │
  │   address    │                             │
  └──────────────┘                             │
         │                                      │
         │              No response             │
         ▼              or corrupted            │
    ◇─────────◇         data                    │
   ╱ Is response ╲                              │
  ◇ acknowledged? ◇──NO────────────────────────▶│
   ╲             ╱
    ◇─────────◇
         │
        Yes
         │
         ▼
  ┌──────────────────┐   First node selects the second one.
  │ Server sends "Off line"│  The process is being repeated
  │     request      │   accross all nodes and chains
  └──────────────────┘   until last node.
         │
         ▼
```

Fig. 5. Daisy chain reset and addressing process

Start
regular
scan

Send reset request
to first node

Select first
node

Server sends request to
first node. The node is
being selected and confirm
it via BROADCAST IN
line

Is response
acknowledged?

NO

No response
or corrupted
data

Yes

Response accepted

Server ask for
test data

First node accepts address
and send back data package

Are the data
acknowledged?

NO

No response
or corrupted
data

Yes

Server sends "Off line"
request

First node is de-selected.
The process is beisng
repeated with the second
node and accross all
nodes in the chain until
last node.

After third loop
display message
"Probbe #.. fail"

Start prrocess with
the next node

Fig. 6. Daisy chain regular scan

$$P = XX \quad X_1Y_1Z_1 \quad X_2Y_2Z_2 \quad X_3Y_3Z_3 \quad X_4Y_4Z_4 \quad CS \quad V$$

- Probe status
- Checksum for data verification
- ADC data. Channel 4
- ADC data. Channel 3
- ADC data. Channel 2
- ADC data. Channel 1
- Probe address
- Start bits
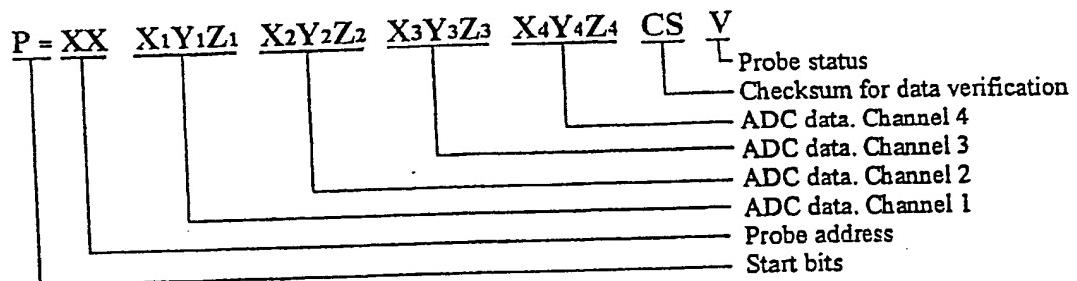
Fig. 7. Daisy chain communication data structre

Current

Discharge
cancellation
point

Time

Discharge
threshold

Discharge
event #1
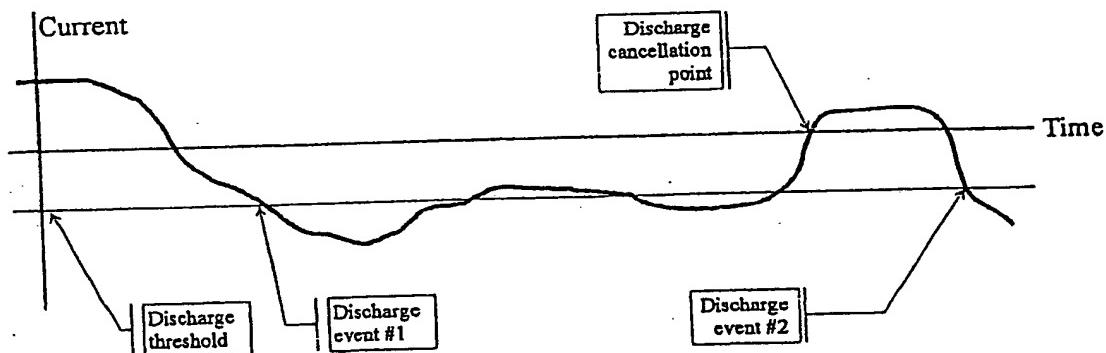
Discharge
event #2

Fig. 8. Discharge event definition

Discharge
Current

Discharge
count #1

Discharge
count #2

Zero level

Time

Discharge
threshold

Stop energy
count

Stop energy
count
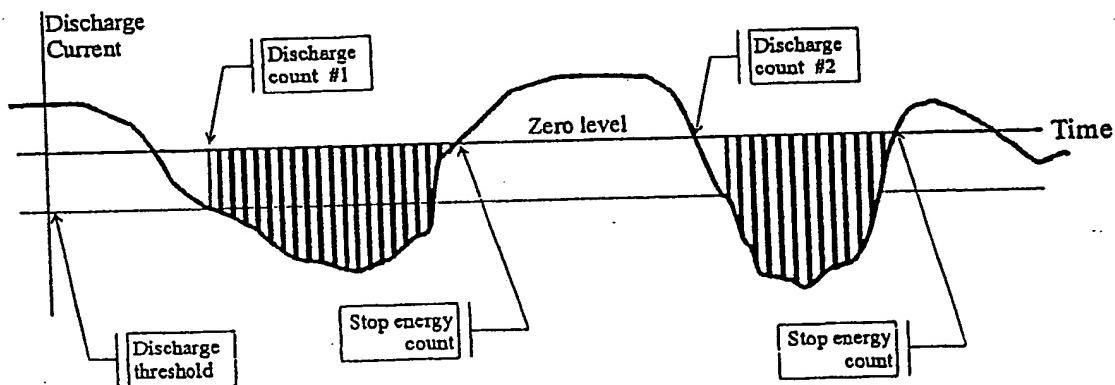
Fig. 9. Graphical presentation of discharge events and energy count

Positive rail

BPP 1 — B1

BPP 2 — B2

BPP 3 — B3

BPP 4 — B4

BPP 5 — B5

BPP 6 — B6

BPP 7 — B7

BPP 8 — B8

BPP 9 — B9

BPP 10 — B10

RVP

CUR 1

System server

AUX

BAT

CUR

AC Current injections means

Negative rail
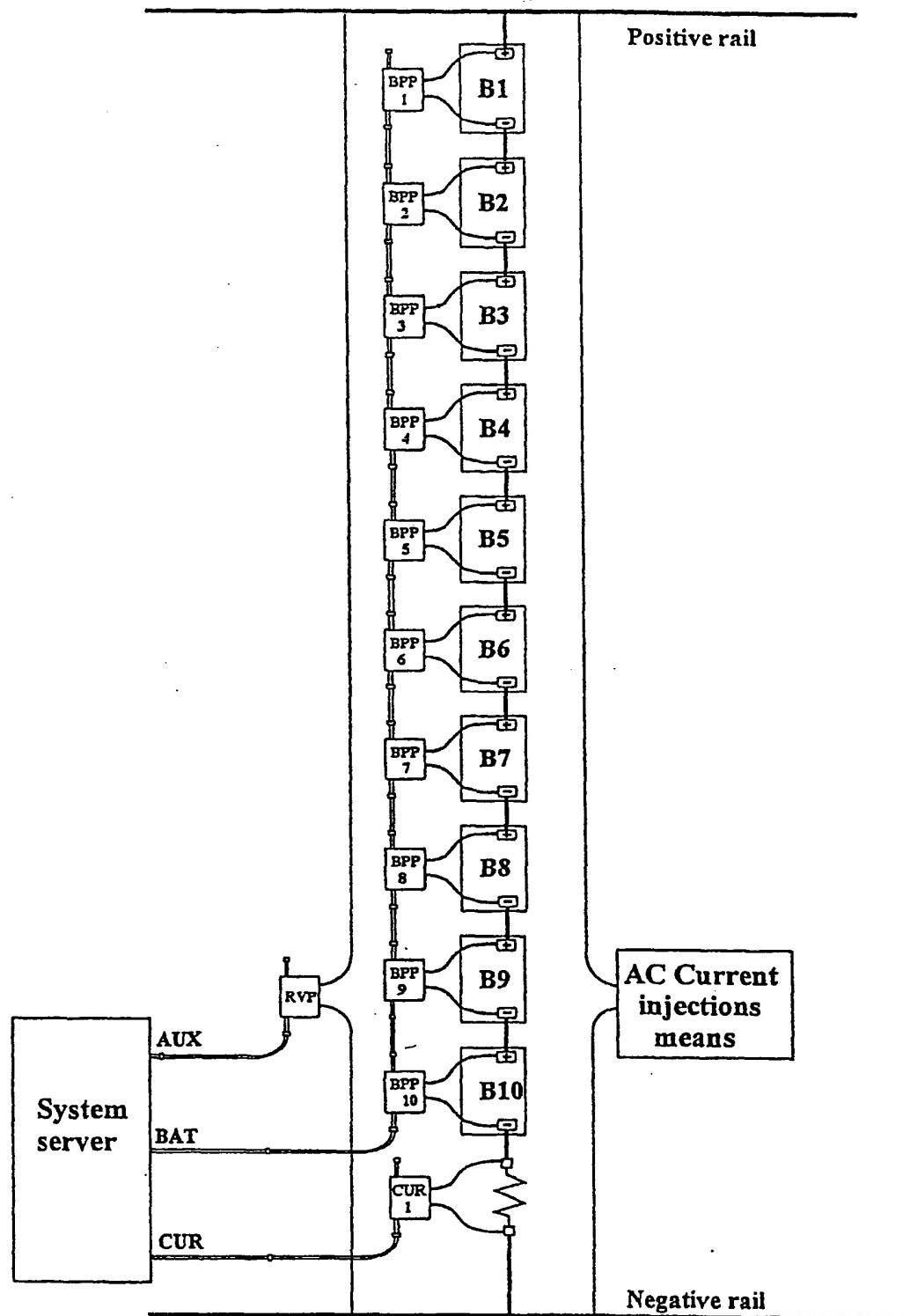
Fig. 10. Monitoring system block diagram